UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
166 Water Street
Woods Hole, MA 02543

June 19, 2000

CRUISE RESULTS

NOAA Fisheries Vessel DELAWARE II
Cruise DE 99-09 (Parts I – IV)

Fall Herring Acoustic Survey

CRUISE PERIOD AND AREA

The 1999 Atlantic Herring Hydroacoustic Survey was conducted in four parts from September 9 to October 15, 1999. Areas of operation were the continental shelf (depths to 300 m) in the Gulf of Maine and Georges Bank regions, including the Canadian Exclusive Economic Zone on eastern Georges Bank (Fig. 1 - 3). Part I was conducted from September 9 - 11 in Cape Cod Bay and Gulf of Maine (Fig. 1). A portcall was made during September 11 - 12 to exchange scientific staff. Survey operations continued during Part II on September 12 - 16 (Fig. 1) and during Part III on September 21 - 30 (Fig. 2). During Part IV, a broad-scale systematic survey was conducted across Georges Bank on October 5 - 14 (Fig. 3).

OBJECTIVES

Cruise objectives were to (1) calibrate the EK500 echosounder system, (2) test the High Speed Mid-water Rope Trawl (HSMRT) performance, (3) survey selected historic spawning areas of Atlantic herring stocks to provide fisheries independent abundance estimates, (4) ground-truth species-specific acoustic estimates using mid-water trawls and underwater video, (5) conduct an *in-situ* multi-frequency target strength (TS) experiment on herring, and (6) test and evaluate new technologies (e.g., broad-band acoustics) for improving fisheries acoustics estimates.

METHODS

Acoustic, mid-water trawl, and video data were collected during the herring acoustic survey in the Gulf of Maine and on Georges Bank. The overall sampling design was to survey selected areas in the Gulf of Maine and Georges Bank regions where Atlantic herring are known to historically aggregate during their spawning season. Data were primarily collected along continuous tracks (transects) within a specified area. The lengths and distances between transects were chosen to cover the bathymetric features which delimited each area. A transect was defined as a continuous track with a single heading and constant ship speed. Parallel transects were defined as a series of parallel coordinated vessel tracks within a specified area. Cross-over transects were tracks perpendicular to parallel transects for traveling between parallel transects, and were generally not used for abundance estimates. A zig-zag design was typically used to survey an elongated area aligned with a shoreline or bathymetric contours. A zig-zag survey consists of a series of coordinated transects where the ending of the previous track and the beginning of the next track occur in the same location and the angle between transects is consistent (Fig. 2).

Gear deployments were made intermittently along transects. Upon completion of a gear deployment, the transect number was resumed when the vessel resumed the track at approximately the same location with the same previous heading. If the vessel heading changed or the vessel did not resume near the end of the previous track, the transect number was sequentially incremented. All areas were surveyed using a parallel transect design, and the northern flank of Georges Bank was also surveyed using a zig-zag design during part III (Fig. 1-3). In general, acoustic data were not collected while the FRV DELAWARE was steaming between survey areas because this time was used for data management. Where possible (i.e. a series of transects were completed within daylight and repeated during darkness hours) one series of transects were conducted during day and then repeated during night. Otherwise, surveys were conducted continuously regardless of time of day. Vessel speed during all surveys was designated at 10 knots, with the exception of the Monhegan Island survey which was conducted at approximately eight knots. Actual survey speeds ranged from 8-11 knots depending on weather conditions and currents.

Deployment (mid-water trawl, *in situ* acoustic backscatter measurements, video, and acoustic broadband measurements) locations were chosen during each area survey (i.e. adaptive strategy). Deployments served to verify species composition comprising acoustic backscatter, and locations were chosen to sample scattering patterns or features observed in acoustic echograms. Our goal was to deploy the midwater trawl about four times per 24 hour period to provide evenly spaced catch data for each area and to relate scattering patterns or features such as aggregations, layers, or dispersed distributions observed in echograms to specific or representative species compositions. The deployments were typically targeted on fish backscatter.

<u>Geographic Areas</u>:

Surveys sites were Monhegan Island, Jeffreys Ledge, the Cove at Jeffreys, Platts Bank, Cashes Ledge, Fippennies Ledge, the northern portion of the Great South Channel, the Franklin Swell area, and Georges Bank (Fig. 1-3). The area southeast of Monhegan Island was surveyed in conjunction with the Fishing Vessel MARY ELLEN. The FV MARY ELLEN's echosounder was outfitted with a data collection system for obtaining quantitative abundance and biomass estimates by commercial vessels. The coordinated survey near Monhegan Island was designed to compare abundance and biomass estimates between the FRV DELAWARE's scientific echosounder and the FV MARY ELLEN's acoustic system. Roughly parallel transects were designed by Phil Yund (Gulf of Maine Aquarium) to cover an area which had reports from commercial fishermen of having Atlantic herring prior to the beginning of our cruise. The FRV DELAWARE and FV MARY ELLEN cruised parallel to each other, with the MARY

ELLEN one hundred meters in front of the DELAWARE, straddling each transect. Surveys on Jeffreys Ledge, Platts Bank, Cashes Ledge, and Fippennies Ledge consisted of parallel transects with two nautical mile spacing between transects. The direction of parallel transects was perpendicular to the main bathymetric features of each area. Transect series were repeated on Jeffreys, Platts, and Fippennies by turning the vessel around at the completion of a series, and repeating the same transects in the opposite direction. A single survey was conducted on Cashes Ledge. Ten overlying transects (approximately ten nautical miles in length) were repeated over a diel cycle on the Cove at Jeffreys Ledge (southwest portion of Jeffreys Ledge). This series of transects was designed to compare herring behavior and acoustic backscattering characteristics among dawn, day, dusk, and night periods. The Franklin Swell area was surveyed using a set of parallel transects with five nautical mile spacing between transects. The northern extent of the Great South Channel was surveyed using a zig-zag pattern.

The area between the 50 m and 250 m bathymetric contours on the northern flank of Georges Bank was surveyed twice during part III with two series of approximately 15 nautical mile long zig-zag transects. The 50 and 250 m isobaths were chosen because Atlantic herring aggregations have historically been observed in the area between these bathymetric contours. The second series of transects was a north-south mirror image of the first and in the same area (Fig. 2). The purpose of flipping the second series relative to the first set of transects was to compare abundance estimates within the same geographic area with a different set of sampling locations. Georges Bank was also surveyed during part IV using a series of parallel transects (five nautical mile spacing between transects) that circumscribed the bank (Fig. 3). This survey covered the area between the 20 m and 250 m bathymetric contours.

Acoustic Data:

Acoustic data used for abundance and biomass estimates of Atlantic herring were collected with the Simrad EK500 scientific echosounder (v.5.30) operating three transducers (38 and 120 kHz split-beam transducers, and a single-beam 12 kHz transducer). The three frequencies were transmitted simultaneously at a ping rate of one ping per two seconds. The EK500 was calibrated using the Simrad “Lobe” program (v.95-01-17) at the beginning of the cruise in Cape Cod Bay, and the calibration constants were input to the EK500 operating parameters. EK500 data were simultaneously transmitted to a Sun Sparc 5 workstation and a PC computer for storage and post-processing. EK500 data consisted of echogram data (binary files with acoustic signals vertically integrated into 0.5 m bins) and a relational INGRES database.

EK500 data were post-processed on the Sun workstation using Simrad’s BI500 (v.1.9.1996) post-processing package during the cruise. Post-processing includes removing bottom interference from the water column signal and apportioning acoustic backscatter to species composition. Data for all three frequencies were post-processed and apportioned to herring backscatter while at sea. When apportioning acoustic backscatter, mid-water trawl catches were used to determine the species composition, and the proportion of herring scatter was set using the 38 kHz data. Equivalent proportions of herring backscatter used with the 38 kHz data were applied to the processing of the 12 and 120 kHz data. After each part of the cruise was completed, EK500 data (echogram files and the INGRES database) were downloaded to a shore-based computer at NEFSC for archiving. EK500 data transmitted to the PC computer were collected and stored using SonarData's EchoLog software package. These data were also downloaded to a shore-based computer at NEFSC for archival and post-processing with SonarData's EchoView software package at a later date.

The EK500 processed each acoustic signal (ping) by correcting for beam pattern effects, calibration constants, and hardware gains, and then vertically integrated the data into 0.5 m bins (echogram data). Each half-meter bin is volume backscatter (S_v) with units of m^2/m^3 and is a quantitative measure of relative density. To remove acoustic scattering by non-swimbladdered fish, invertebrates, and zooplankton from backscatter by swimbladdered fish (e.g., herring), we set a minimum volume backscatter threshold of -61 dB (dB = 10 $\log_{10}(S_v)$). For preliminary data analysis and diagnostics, volume backscatter were vertically integrated from a specified depth below the surface ("bubble layer") to 0.5 m above the bottom. Data between the surface and the bubble layer were not included in the analysis to eliminate scattering by surface bubbles and noise. The bubble layer was set to 10 m for the 38 and 120 kHz data. The bubble layer was set to 32 m for the 12 kHz data as the upper 32 m of the 12 kHz data have significant noise from the "ring-down" of the transducer. Vertical integration of volume backscatter from the bubble layer to the bottom gives areal density estimates (S_a) with units of m^2/m^2 for all scatterers in the water column. The BI500 then scaled these density estimates from m^2/m^2 to nautical mile squared ($m^2/nm^2 = S_a * 1852\ m^2/nm^2$). We calculated S_a at 0.5 nautical mile intervals. S_a values are an index of relative areal density, and further analysis is required to produce numeric abundance and biomass estimates for a survey area.

The 55-64 kHz Furuno omni-directional sonar was operated periodically in the vicinity of herring aggregations. Analog images from this sonar were obtained using a video "frame-grabber" to capture images from the Furuno sonar at 15 second intervals. These images were stored on a PC and then downloaded to a shore-based computer for archival and analysis in the laboratory.

<u>Trawl Data</u>:

A High Speed Mid-water Rope Trawl (HSMRT design R202825A) built by Gourock Trawls (refer to the DE 98-09 cruise report for details), was used to verify species composition of acoustic backscatter. The HSMRT is a rope-trawl design with a 13 ± 3 m vertical and 27 ± 5 m horizontal mouth opening. Trawl hauls were conducted at a vessel speed averaging 4.5 knots. Trawl performance was measured with a Simrad FS903 system, a Simrad ITI system, and a pair of Vemco temperature-depth Minilog sensors. The FS903 system was attached to the headrope, and consists of a rotating transducer head and a temperature-depth sensor. The direction of rotation of the transducer was perpendicular to the longitudinal axis of the net to scan the mouth opening of the net. Data (e.g. depth, temperature, and vertical and horizontal net opening) from the FS903 were transmitted through a third-wire conductor cable and constant tension winch to a video monitor. The ITI sensors were attached to the trawl doors and wings. During the cruise, the wing sensors were not always operational. Data from the ITI sensors were acoustically transmitted to the ship and displayed on a monitor. Trawl performance data from the ITI and FS903 systems were recorded onto log sheets. The Minilog probes were attached to the HSMRT head and foot ropes. Temperature and depth data were immediately downloaded after each trawl to a PC computer for archiving and later analysis.

Trawl catches were processed using standard NEFSC Survey procedures whereas fish and squid were sorted by species, total weights (nearest 0.1 kg), and length frequencies (fork lengths to the nearest cm) were recorded. Individual weights (nearest 0.1 g) and individual lengths (both total and fork length to the nearest mm) were recorded for approximately 150 Atlantic herring and 150 silver hake per catch. Biological samples (otoliths for age and growth, and examination of stomach contents at sea) were taken for Atlantic herring at each station (one fish per cm length interval). Trawl station, catch, and biological data were recorded on standard NEFSC trawl logs for entry, auditing, and implementation into the NEFSC database.

Trawl duration, tow depths, and tow speeds were not standardized or consistent between trawls and catch data should not be used for abundance estimates. We are currently utilizing trawl catch information to verify acoustic backscatter, thus the mid-water trawl was often targeted at specific aggregations or layers in the water column. Tow depths were chosen by observing EK500 echograms and bridge real time displays for aggregation and layer depths, and also by incorporating the real time display of the FS903. Typical trawl duration was 30 minutes, however the trawl was often “dipped” into the aggregation for as little as a minute when subsampling large herring aggregations.

Other Data:

During part II of the cruise, Gerald Denny of Scientific Fisheries Incorporated (Anchorage, Alaska), conducted acoustic measurements with a broadband acoustic system. The towbody was suspended from the forward A-frame while the DELAWARE was drifting. Acoustic data from the broadband system was collected and analyzed using a Scientific Fisheries software package. Unfortunately, his system was inoperative due to a damaged transceiver card and no data were analyzed.

During parts I and II of the cruise, an underwater video system was deployed into herring aggregations to record species composition and herring behavior. The Static Underwater Stereo Video System (SUSVS) consists of two color cameras mounted for stereo vision, a pair of lasers for measuring distance between the laser beams within the view of the cameras, a pair of floodlights, and a Jasco Attitude Sensor which recorded real-time depth, temperature, and three-dimensional roll-tilt-pitch. The SUSVS was deployed from the forward A-frame while the FRV DELAWARE drifted over backscatter aggregations. Video images were transmitted through a conductor cable via portable winch system to two (one for each camera) video taping machines. Each frame was time-stamped with a time-code generator so that images from each camera can be coordinated with each other and in time. Data from the Jasco sensor were transmitted for real-time monitoring of the towbody and the data were recorded to a PC computer.

In situ acoustic backscattering experiments were conducted during parts I and II. Backscattering measurements were obtained by allowing the ship to drift over herring aggregations. Volume backscatter and backscattering from individual fish were recorded by the EK500 and stored for post-processing and analysis.

RESULTS

A total of 55 deployments were conducted during the fall herring acoustic survey (Fig. 4, Table 1). The SUSVS underwater video system was deployed nine times, *in situ* acoustic backscatter measurements were conducted three times, and the Scientific Fisheries Broadband system was deployed four times on Jeffreys Ledge and the Cove at Jeffreys. Thirty nine HSMRT mid-water trawls were conducted throughout the cruise with twenty two deployed on Georges Bank. Spiny dogfish, longfin and shortfin squid, crustacean shrimp species, and twenty four species of fish, were caught in mid-water trawl hauls 2-54. The final mid-water trawl (55) was towed to a depth of approximately 500 m in the Oceanographer Canyon (off the southern flank of Georges Bank), and added eight classified and numerous unclassified fish species to the total number of species caught. Atlantic herring were caught near Monhegan Island during part I, on Jeffreys Ledge and the Cove at Jeffreys during Part II, and on Georges Bank during parts III and IV. Two mid-water tows were completed on Jeffreys Ledge during Part III, but no Atlantic herring were captured. Atlantic herring were not captured in mid-water tows on Cashes Ledge, Platts Bank, or Fippennies Ledge.

A total of 342 transects, comprising over 4800 nautical miles, were conducted during the fall herring acoustic cruise (Fig. 1 - 3).

Herring were captured in the southwest portion of Jeffreys Ledge and in the Cove area during Part II. Jeffreys Ledge was surveyed again on the 22 - 23 September (Part III) and small potential herring aggregations were observed in the acoustic data, but no herring were caught in the trawl. Platts Bank and Fippennies Ledge were surveyed twice during Part III with each series of parallel transects conducted sequentially in each area. No herring were caught in mid-water trawl hauls in the Platts Bank and Fippennies Ledge survey areas. Cashes Ledge was surveyed once during Part III.

The northern flank of Georges Bank was surveyed using a zig-zag pattern during Part III (Fig. 2). Atlantic herring were caught in midwater tows conducted between the 100 and 250 bathymetric contours during this survey. The HSMRT was set on a large aggregation near the eastern end of the survey area and spawning (ripe and running) Atlantic herring were captured. The Franklin Swell area was surveyed once during Part III with a series of seven parallel transects (Fig. 2), but no midwater trawl hauls were conducted.

During Part IV a series of parallel transects were conducted that circumscribed Georges Bank and surveyed the Franklin Swell region (Fig. 3). These transects covered the portion of Georges Bank between the 20 m and 250 m bathymetric contours. Atlantic herring were caught in midwater trawls on the northern flank of Georges Bank and Franklin Swell area. Atlantic herring were not caught in midwater tows on the northeast peak or on the southern side of Georges Bank.

DISPOSITION OF DATA

The 12, 38, and 120 kHz acoustic data collected by the EK500 will be available through the NEFSC. A CD-ROM containing the eventlog, transect, station, and trawl summary tables and post-processed Sa data will be provided to the Canadian Department of Fisheries and Oceans (DFO). All other data are available through NEFSC.

SCIENTIFIC PERSONNEL

National Marine Fisheries Service, NEFSC, Woods Hole, MA

William Michaels	Chief Scientist	Parts I, II, IV
Michael Jech	Research Fisheries Biologist (Chief Scientist - III)	Parts I, II, III, IV
Vaughn Silva,	Biological Fisheries Technician	Parts I, II
Cheryl Ryder,	Research Fisheries Biologist	Part I
William Overholtz	Research Fisheries Biologist	Part III
Jon Brodziak,	Research Fisheries Biologist	Part III

National Marine Fisheries Service Headquarters, Silver Springs, MD

Stephen Brown	Research Fisheries Biologist	Part II

United States Fish and Wildlife Service, Conway, NH

Kevin Schreier	Fisheries Biologist	Part IV

Contractors

Wei-Li Diana Ma	Fisheries Acoustic Technician	Parts I, II, III, IV
Richard Yetter	Fisheries Acoustic Technician	Parts, I, II, III, IV
Kara Dwyer	Fisheries Acoustic Technician	Parts, II, III, IV

Scientific Fisheries Incorporated, Anchorage, AK

Gerald Denny	Acoustical Engineer	Part II

Woods Hole Oceanographic Institution, Woods Hole, MA

Richard Crawford	Fisheries Biologist	Part III

Shedd Aquarium, Chicago, IL

Mary Ciesla	Visiting Scientist	Part IV

Loyola University, Chicago, IL

Richard Fay	Visiting Scientist	Part IV

Boston University Marine Program, Boston, MA

Dana Wright	Student Volunteer	Part IV
Amy Lamb	Student Volunteer	Part III
Dolores Weisbaum	Student Volunteer	Part III

Marine Biological Laboratory, Woods Hole, MA

Carla Guenther	Research Assistant	Part IV
Jaimie Champagne	Research Assistant	Part III

University of New Hampshire, NH

Deborah Chlorty	Student Volunteer	Part III

****
For further information please contact: William Michaels, National Marine Fisheries Service, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts 02543-1097. Telephone (508) 495-2259; Fax (508) 495-2258.
Email: William.Michaels@noaa.gov
****

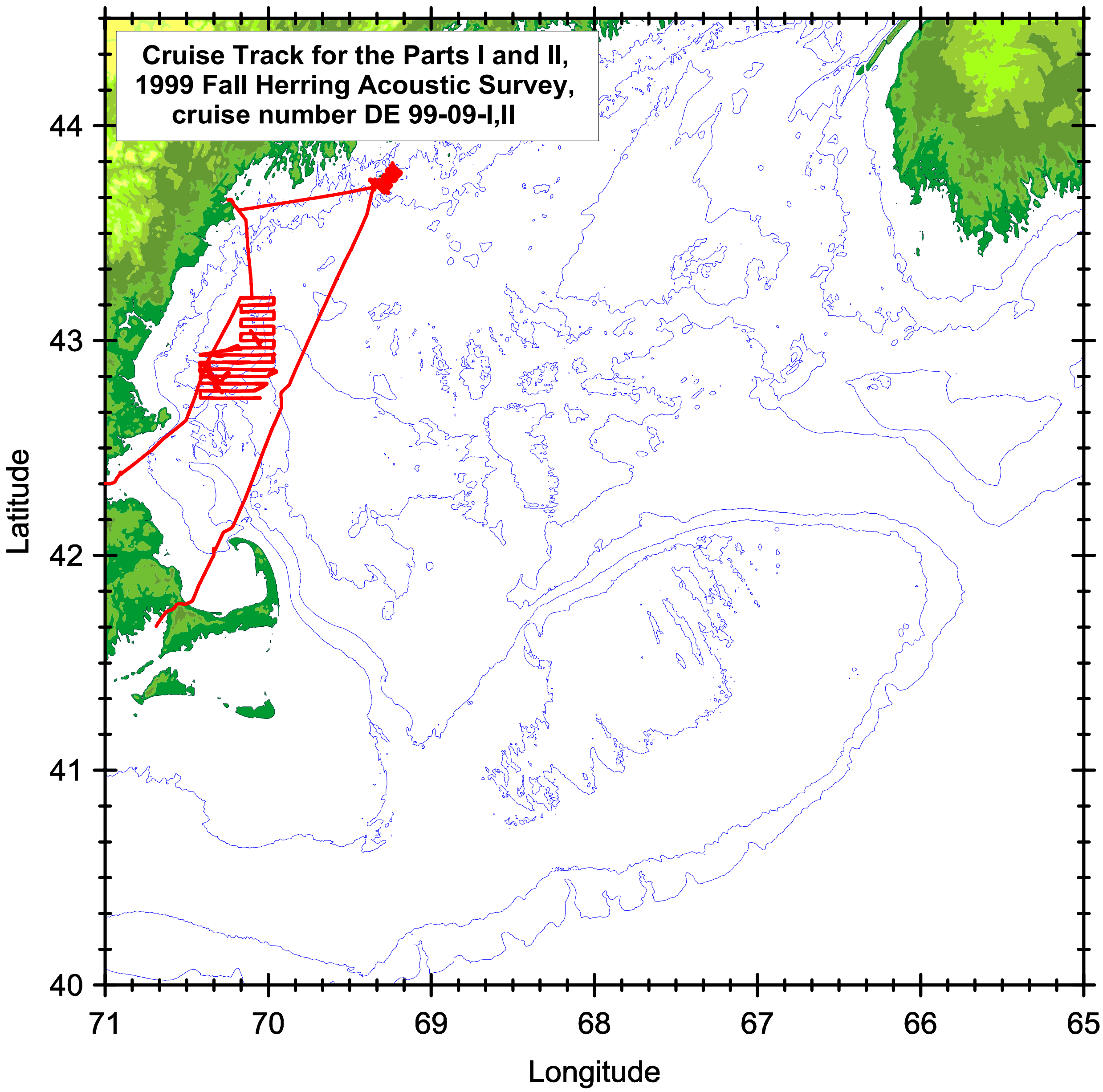

Figure 1. Cruise track for Parts I and II of the 1999 Fall Herring Acoustic Survey (cruise DE 99-09) during September 8 - 16, 1999.

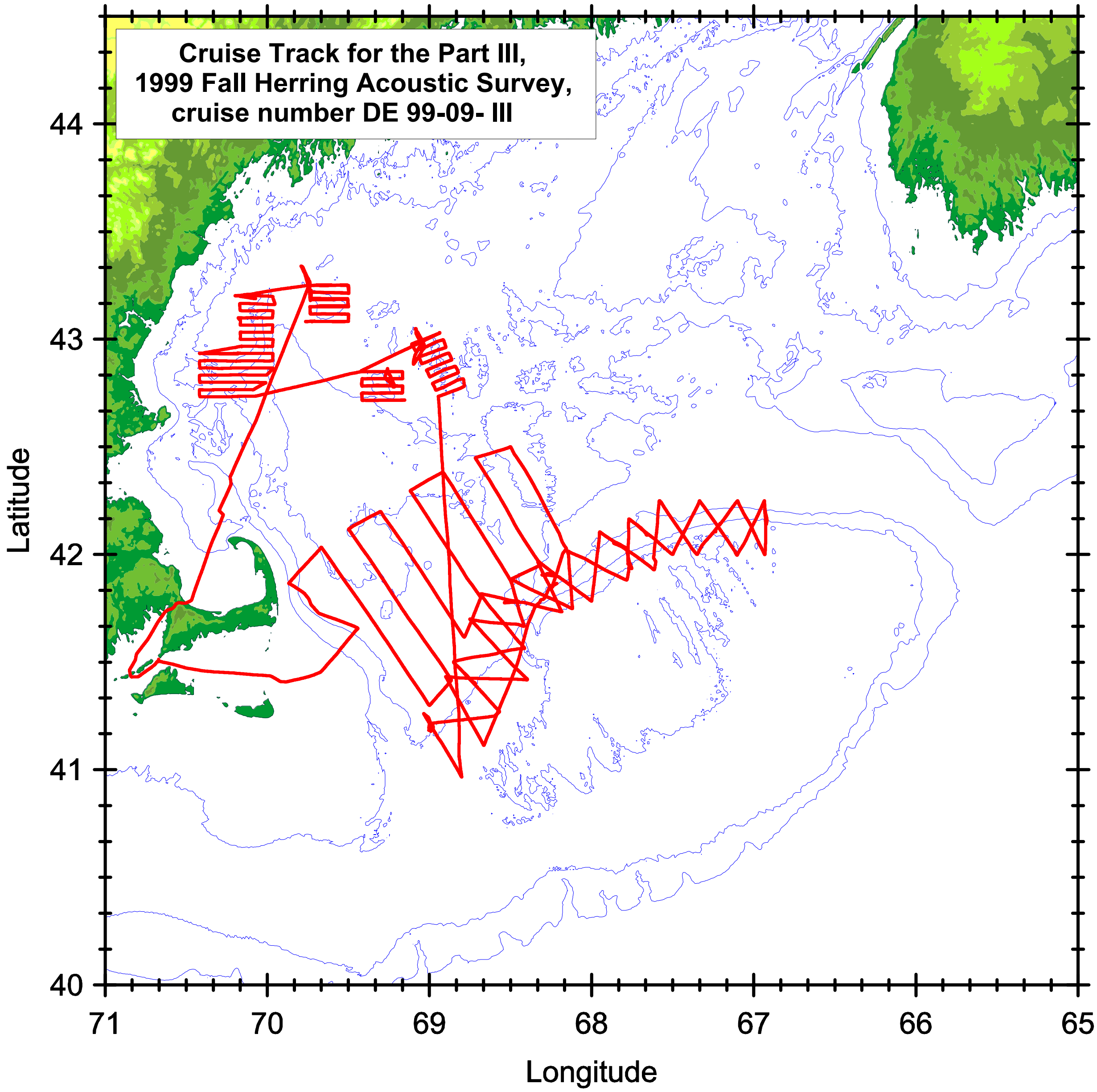

Figure 2. Cruise track for Part III of the 1999 Fall Herring Acoustic Survey (cruise DE 99-09) during September 21 - 30, 1999.

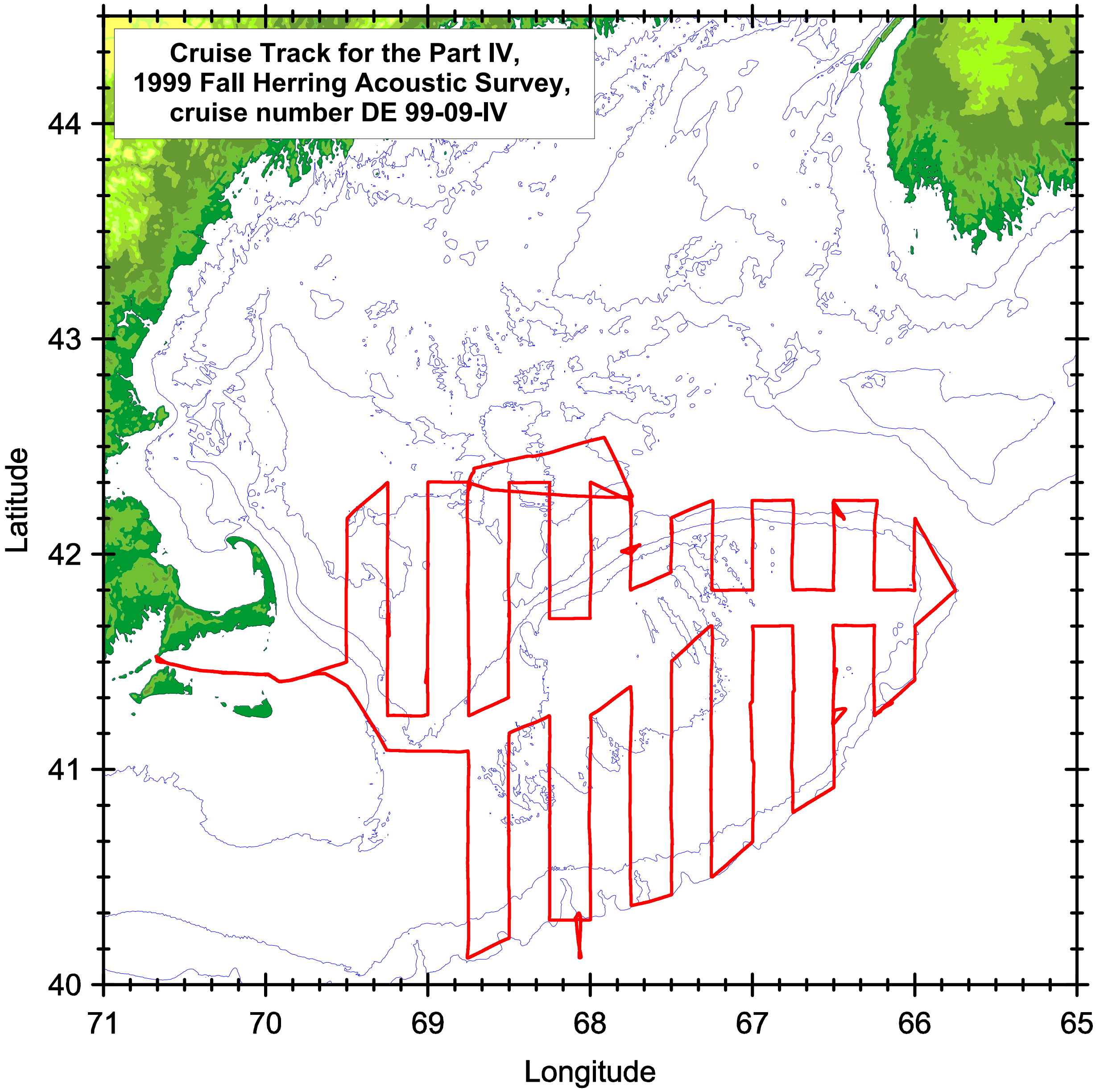

Figure 3. Cruise track for Part IV of the 1999 Fall Herring Acoustic Survey (cruise DE 99-09) during October 5 - 14, 1999.

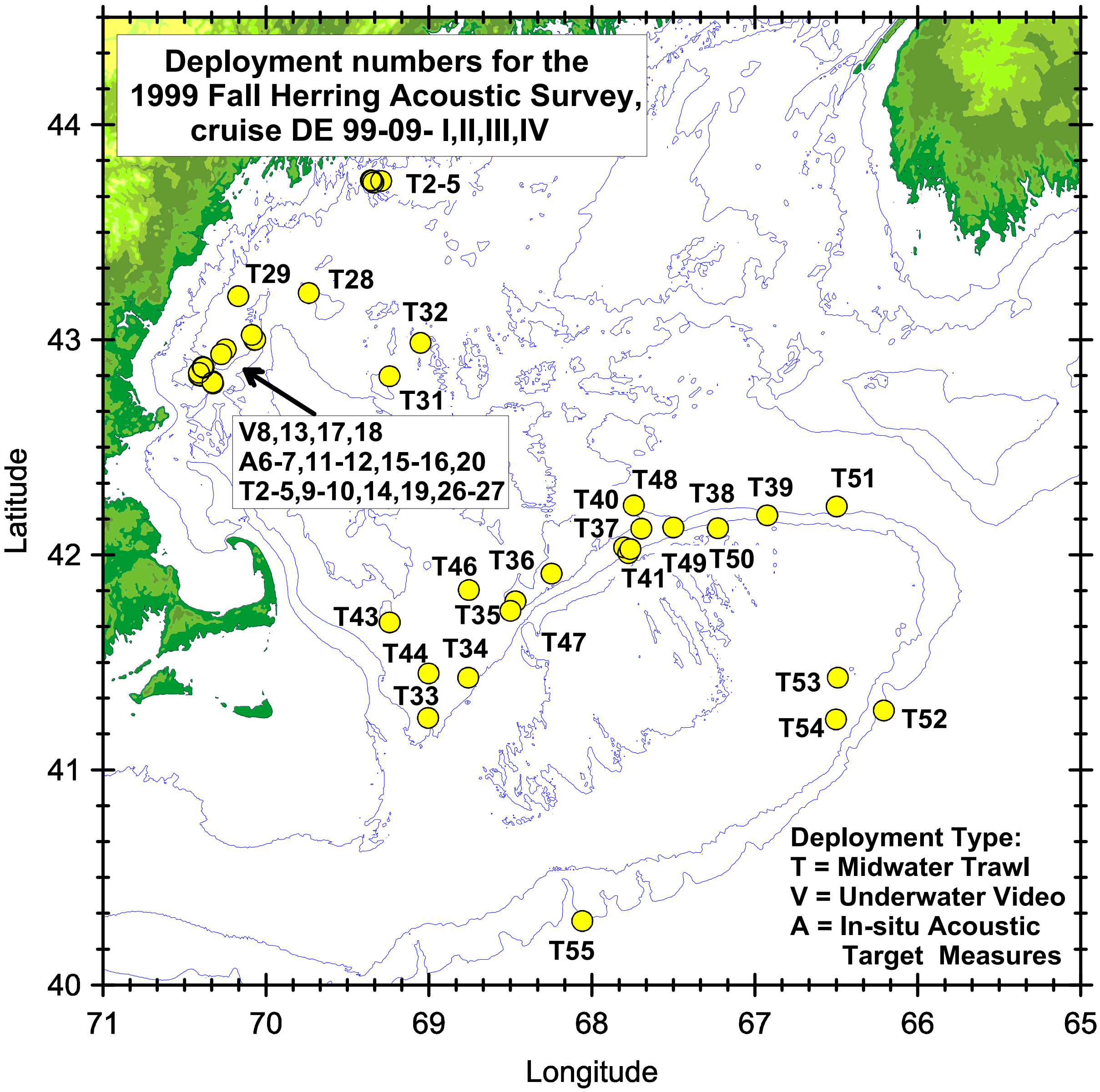

Figure 4. Location and numbers for deployments (T = midwater trawl, V = underwater video, A = acoustic target measurement conducted during an *in-situ* experiment) for the 1999 Fall Herring Acoustic Survey (cruise DE 99-09, Parts I - IV) during September 8 - October 14, 1999.

Table 1. DE9909 herring acoustic survey deployment table. Dply is the deployment number, HSMRT denotes High Speed Mid-water Trawl deployment, TS denotes *in -situ* acoustic backscatter measurements, BRDBAND denotes Scientific Fisheries Broadband acoustic measurements, VIDEO denotes video deployment, Vlog denotes the EK500 vessel log. If stations were conducted along a transect, the transect number (Trnsct) is given. Times are given in Greenwich Mean Time (GMT) and dates are Day/Month/Year. Local time during this cruise was Eastern Daylight Savings Time (EDT). EDT = GMT - 4 hours.

Site	Trans	Deploy	Gear	B_Date	B_Time	B_Lat	B_Long	B_Vlog	E_Date	E_Time	E_Vlog
Gulf_Maine		1	HSMRT	9/9/1999	17:42:04	43 42.76	69 21.07	1.68	9/9/1999	18:11:16	2.53
Monhegan_I	26	2	HSMRT	9/10/1999	7:05:34	43 43.86	69 20.46	74.48	9/10/1999	7:46:50	77.10
Monhegan_I		3	HSMRT	9/10/1999	18:29:48	43 44.50	69 21.36	152.35	9/10/1999	19:13:49	154.91
Monhegan_I		4	HSMRT	9/10/1999	20:16:20	43 44.37	69 20.89	160.30	9/10/1999	20:58:09	162.93
Monhegan_I		5	HSMRT	9/11/1999	5:35:48	43 44.31	69 17.57	235.34	9/11/1999	5:49:48	236.16
Jeffreys_L	96	6	TS	9/13/1999	3:46:17	42 59.97	70 04.23	390.40	9/13/1999	4:21:27	390.80
Jeffreys_L	96	7	BRDBAN	9/13/1999	4:41:36	42 59.93	70 04.25	391.37	9/13/1999	7:07:37	392.65
Jeffreys_L		8	VIDEO	9/13/1999	7:23:04	43 00.03	70 03.98	394.00	9/13/1999	7:52:57	394.19
Jeffreys_L		9	HSMRT	9/13/1999	8:52:01	43 01.34	70 05.22	399.45	9/13/1999	9:25:01	401.65
Jeffreys_L	99	10	HSMRT	9/13/1999	12:36:31	42 57.33	70 14.87	427.87	9/13/1999	13:10:08	429.86
Jeffreys_L	108	11	TS	9/14/1999	0:15:04	42 48.29	70 19.86	535.35	9/14/1999	0:22:35	535.60
Jeffreys_L	108	12	BRDBAN	9/14/1999	0:37:51	42 48.42	70 19.70	535.87	9/14/1999	1:07:10	536.46
Jeffreys_L	108	13	VIDEO	9/14/1999	1:27:05	42 47.80	70 19.49	537.13	9/14/1999	2:06:46	537.86
Jeffreys_L	108	14	HSMRT	9/14/1999	2:51:52	42 48.10	70 19.66	540.70	9/14/1999	3:05:36	541.47
Jeffreys_L	119	15	TS	9/14/1999	14:45:30	42 50.09	70 24.64	657.72	9/14/1999	15:11:31	658.31
Jeffreys_L	119	16	BRDBAN	9/14/1999	15:13:34	42 50.03	70 24.63	658.32	9/14/1999	15:48:13	659.30
Jeffreys_L	119	17	VIDEO	9/14/1999	15:51:01	42 50.12	70 24.45	659.43	9/14/1999	16:10:37	660.11
Jeffreys_L	119	18	VIDEO	9/14/1999	16:20:15	42 49.94	70 24.03	660.67	9/14/1999	16:57:30	661.35
Jeffreys_L	119	19	HSMRT	9/14/1999	17:31:38	42 50.79	70 24.66	664.18	9/14/1999	18:12:17	666.18
The_Cove	144	20	BRDBAN	9/15/1999	19:10:00	42 52.26	70 23.35	894.82	9/15/1999	19:44:02	895.88
The_Cove	144	21	VIDEO	9/15/1999	19:58:59	42 52.29	70 23.25	896.36	9/15/1999	20:23:01	896.71
The_Cove	144	22	VIDEO	9/15/1999	20:32:30	42 51.99	70 23.41	897.16	9/15/1999	20:52:50	897.43
The_Cove	144	23	VIDEO	9/15/1999	20:59:33	42 52.14	70 23.39	897.59	9/15/1999	21:19:14	897.85
The_Cove	151	24	VIDEO	9/16/1999	2:29:02	42 52.05	70 23.05	922.45	9/16/1999	2:48:39	922.74
The_Cove	151	25	VIDEO	9/16/1999	2:52:03	42 52.19	70 23.11	922.84	9/16/1999	3:00:14	922.95

Table 1. Cont.

Site	Trans	Deploy	Gear	B_Date	B_Time	B_Lat	B_Long	B_Vlog	E_Date	E_Time	E_Vlog
The_Cove	151	26	HSMRT	9/16/1999	3:46:58	42 52.23	70 23.01	927.23	9/16/1999	4:02:25	928.22
The_Cove	151	27	HSMRT	9/16/1999	4:27:27	42 52.44	70 23.29	929.88	9/16/1999	4:57:30	931.64
Platts_B	156	28	HSMRT	9/21/1999	15:09:33	43 13.04	69 44.25	1103.03	9/21/1999	15:44:45	1105.30
Jeffreys_L		29	HSMRT	9/22/1999	13:02:44	43 12.15	70 10.21	1266.73	9/22/1999	13:42:39	1269.15
Jeffreys_L	192	30	HSMRT	9/23/1999	1:48:08	42 55.96	70 16.49	1391.65	9/23/1999	2:36:35	1394.69
Fippennies_L	207	31	HSMRT	9/23/1999	21:26:37	42 49.83	69 14.51	1578.57	9/23/1999	22:08:08	1581.04
Cashes_L	225	32	HSMRT	9/24/1999	16:42:59	42 59.13	69 03.08	1749.10	9/24/1999	17:26:52	1751.67
Georges_B	240	33	HSMRT	9/25/1999	15:44:03	41 14.49	69 00.31	1962.58	9/25/1999	16:13:14	1964.30
Georges_B	242	34	HSMRT	9/25/1999	23:30:24	41 25.73	68 45.54	2009.07	9/26/1999	0:03:26	2010.81
Georges_B	245	35	HSMRT	9/26/1999	6:09:21	41 47.03	68 28.16	2072.20	9/26/1999	6:42:30	2074.20
Georges_B	247	36	HSMRT	9/26/1999	11:13:40	41 54.76	68 14.85	2115.86	9/26/1999	11:38:23	2117.34
Georges_B	249	37	HSMRT	9/26/1999	16:38:23	42 02.07	67 48.12	2161.82	9/26/1999	17:11:21	2163.54
Georges_B	252	38	HSMRT	9/26/1999	23:57:32	42 07.42	67 13.59	2229.41	9/27/1999	0:16:33	2230.37
Georges_B	254	39	HSMRT	9/27/1999	4:52:49	42 11.01	66 55.44	2272.53	9/27/1999	5:12:41	2273.69
Georges_B	258	40	HSMRT	9/27/1999	12:59:19	42 07.30	67 41.80	2348.56	9/27/1999	13:32:53	2350.42
Georges_B	259	41	HSMRT	9/27/1999	16:36:18	42 00.46	67 46.60	2374.91	9/27/1999	17:16:23	2377.68
Georges_B	286	43	HSMRT	10/6/1999	5:42:21	41 41.14	69 14.46	3101.21	10/6/1999	6:30:03	3104.05
Georges_B	288	44	HSMRT	10/6/1999	12:51:57	41 26.91	69 00.15	3160.46	10/6/1999	13:21:31	3162.12
Georges_B	289	45	HSMRT	10/6/1999	21:10:36	42 19.43	68 44.89	3234.56	10/6/1999	21:52:17	3237.22
Georges_B	293	46	HSMRT	10/7/1999	14:34:45	41 50.18	68 45.32	3376.73	10/7/1999	15:06:21	3378.77
Georges_B	295	47	HSMRT	10/7/1999	23:20:00	41 44.37	68 29.98	3448.17	10/7/1999	23:21:00	3448.17
Georges_B	301	48	HSMRT	10/8/1999	16:03:08	42 13.78	67 44.57	3603.12	10/8/1999	16:54:23	3606.07
Georges_B	301	49	HSMRT	10/8/1999	20:02:24	42 01.58	67 45.84	3630.62	10/8/1999	20:34:45	3632.68
Georges_B	303	50	HSMRT	10/9/1999	1:00:23	42 07.62	67 30.00	3674.85	10/9/1999	1:20:16	3675.85
Georges_B	311	51	HSMRT	10/9/1999	16:38:02	42 13.48	66 29.87	3823.04	10/9/1999	17:15:53	3825.48
Georges_B	319	52	HSMRT	10/10/1999	8:16:54	41 16.56	66 12.51	3966.05	10/10/1999	8:51:35	3968.29
Georges_B	322	53	HSMRT	10/10/1999	16:55:50	41 25.74	66 29.46	4031.52	10/10/1999	17:17:15	4032.88
Georges_B	322	54	HSMRT	10/10/1999	19:32:05	41 14.08	66 30.13	4050.79	10/10/1999	19:57:52	4052.23
Georges_B	335	55	HSMRT	10/12/1999	23:31:25	40 17.84	68 03.52	4533.67	10/13/1999	2:05:41	4543.22